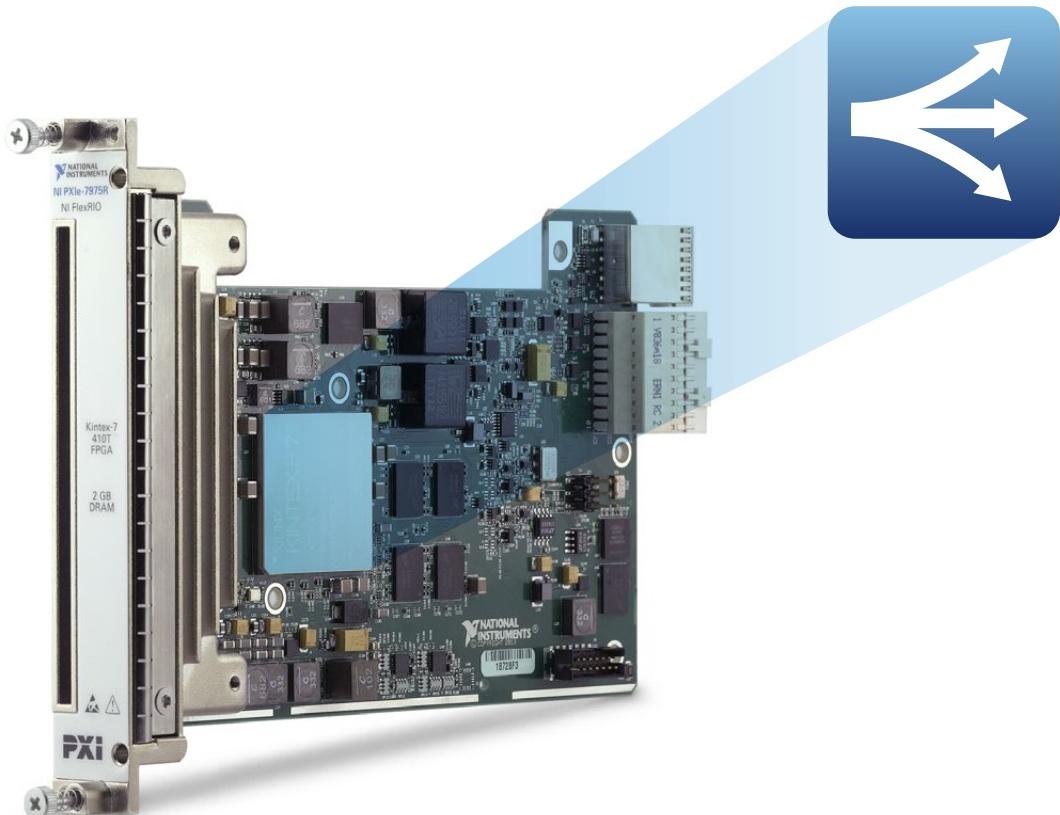


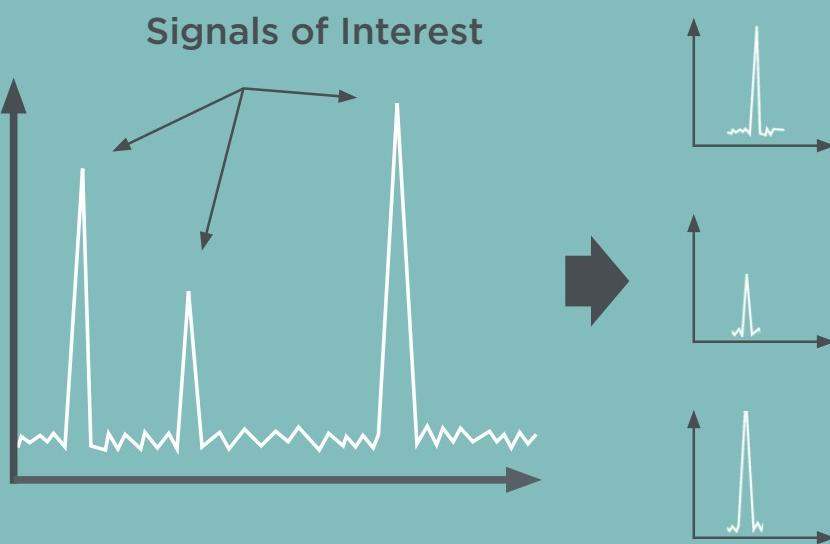
NC-10

LabVIEW Channelizer Solution



Why Channelize?

Spectrum monitoring and signal analysis have many application areas, both civilian and military. As wireless technologies are becoming more common, the RF spectrum gets more crowded and having the right tools to analyze the signals becomes more important. By using channelization techniques it is possible to use a single wideband receiver and still analyze thousands of signals.



When monitoring a wideband source there can be many different signals of interest that must be analyzed, demodulated, decoded or processed in other ways. However, processing the entire wideband for every interesting signal is too CPU intensive. Instead, the signals of interest should be extracted from the wideband source to make it possible to process each signal individually. This can be achieved by filtering and decimation of the wideband signal which results in signals with a lower sample rate that only contains the signal of interest.

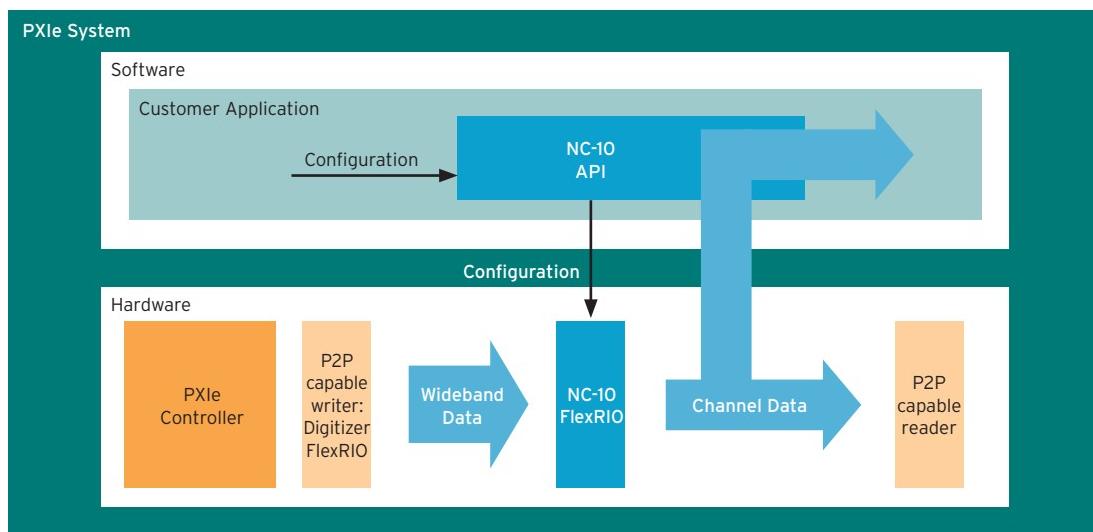
Processing Power

For online monitoring applications the channelization must be done continuously in Real-Time and without disrupting the incoming wideband signal. The more extracted channels, the more processing power is needed and for high channel counts it is impossible for software based solutions to keep up with the incoming data if a single processing computer is used. By using an approach where hardware is tailored for the task, such as with an FPGA, the channels can be extracted efficiently and uninterrupted.



NC-10 FPGA-based Channelizer

Novator Solutions Channelizer NC-10 is an FPGA-based solution that gives you the possibility to extract up to 1024 channels in Real-Time and stream the channels for further processing. NC-10 is powered by ChannelCoreFlex Technology from RFEL LTD., UK.



The system is very flexible and unlike many other channelization approaches, each channel can individually be tuned regarding:

- Center frequency
- Sample rate (bandwidth)
- Gain
- Filter selection
- On/off

It is possible to combine narrow and wide channels and have overlapping channels. The channels can be reconfigured in runtime and reconfiguring one channel does not affect the operation of the other channels.

PXIe-based

The NC-10 is based on the NI FlexRIO board PXIe-7975 featuring a Xilinx Kintex7 FPGA and is the only ready-to-run Channelizer solution for LabVIEW™. The modular PXIe platform makes it easy to integrate the NC-10 into your

own system and transfer data to and from the device.

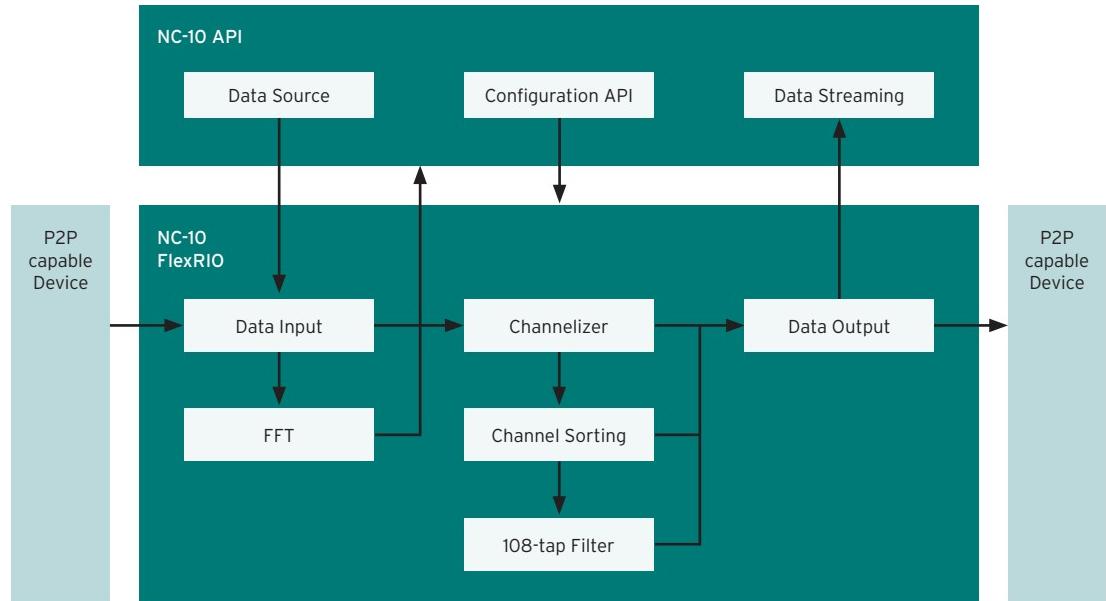
Peer-to-peer communication is a technology used to stream data in the PXI-backplane and NC-10 can be combined with any peer-to-peer compatible NI Digitizer or NI VSA. This makes it possible to stream the incoming data from for example a VSA directly to the NC-10 FPGA without going through the CPU.

Thanks to the modular platform, if an increased channel count is needed multiple NC-10 can be daisy chained via multiple peer-to-peer streams.

Novator Solutions Channelizer NC-10 is a component in the Novator Solutions NCR (Novator Channelized Receiver) product family, a ready-to-run channelizing system including one or multiple receivers (Vector Signal Analyzers from National Instruments). NC-10 is also available separately for customers who want to leverage the power of NC-10 in their own LabVIEW applications. This brochure describes the NC-10 product.

NC-10 Operation

The data input is wideband IQ-data (16-bit I and Q, up to 250MSps) and the output is time interleaved channelized IQ-data. Data can be sent either from the host or from a peer-to-peer capable digitizer. For highest data throughput peer-to-peer is recommended. NC-10 can be run in one of four different modes depending on how the data should be output.



Single Sample Mode

This mode gives the lowest latency and the data is output directly after the Channelizer. Every channel can be processed in one of 33 user configurable 31 tap FIR filters. Data is output as 64-bit samples where 32 bit is the IQ-data and the rest contains information about that specific sample, such as channel number.

Consecutive Samples Mode

Depending on the type of processing performed in downstream nodes, it can be difficult or impossible to handle one single sample at a time. On the NC-10, data from the same channel can be sorted and sent together to make processing in downstream nodes easier. Data from different channels are identified by a header that is sent together with the samples.

Filtered Samples Mode

The sorted data can be run through an additional FIR filter. Unlike the filters available in the Single Sample Mode, these filters can be configured individually for each channel and have a length of 108-taps without any requirements regarding symmetry.

Simulated Mode

A simulation mode is available that lets you prototype your surrounding code without the hardware present. The simulation mode gives you the same feedback regarding configuration settings as the hardware mode would do. Measurement files can be used during simulations so that downstream nodes in your software application can operate on realistic output data.

LabVIEW Programming

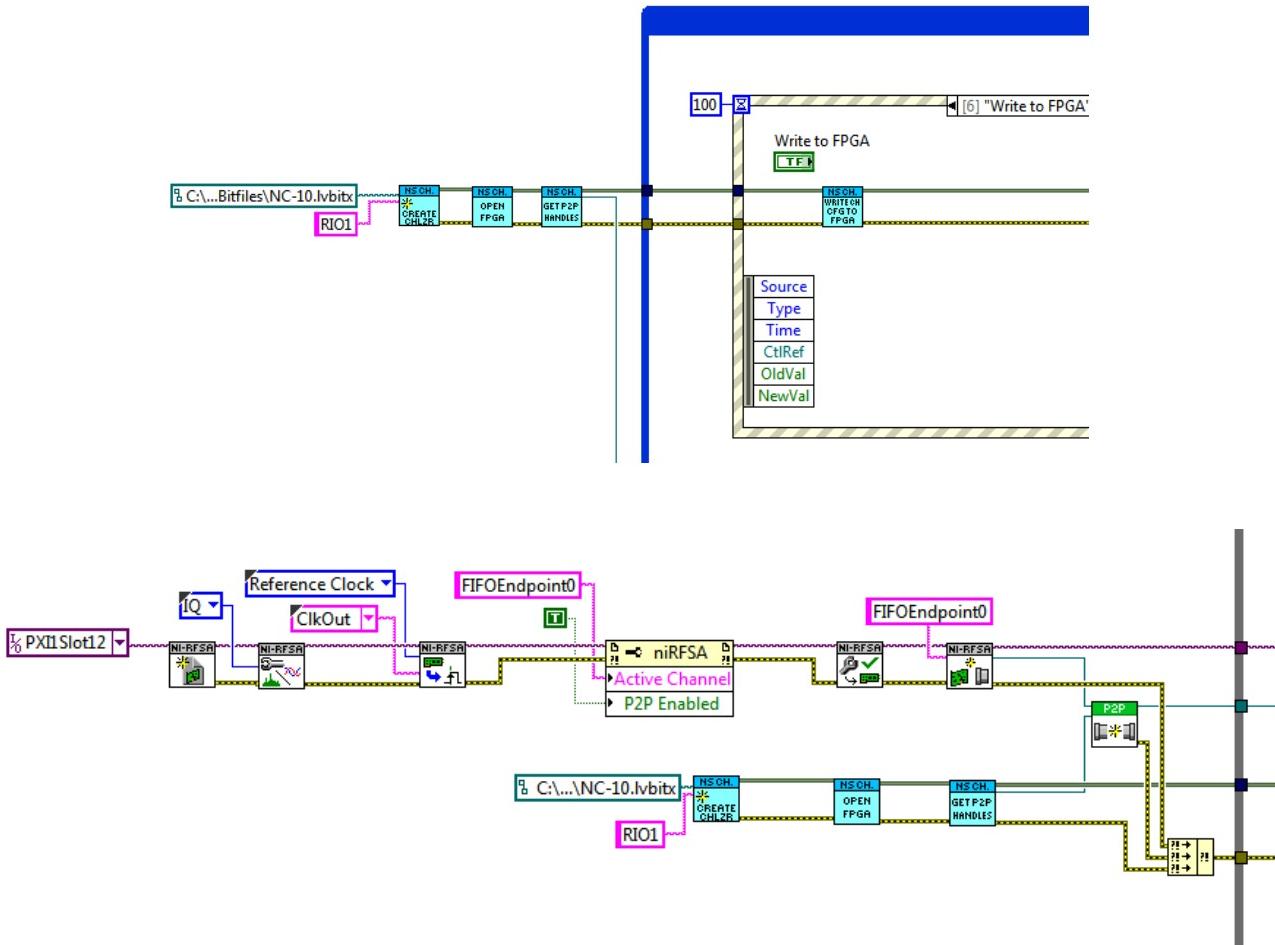
The NC-10 LabVIEW API makes it easy for you to configure the channelizer settings. The API follows the same programming flow as National Instruments drivers, such as NI-DAQmx or NI-RFSA, to make you feel at home when programming. To help you get started there are ready-to-run examples included as well as a user manual and VI documentation.

The API together with the examples makes it possible for new users to get up and running quickly while the advanced functionalities of the API makes it possible for experienced users to tailor the application to their needs. With the API it is possible to both create channelizing application with channel allocation controlled by an operator, automatically or a combination of the two.

NC-10 FPGA functionality is delivered as a bitfile and LabVIEW FPGA Module is not required to integrate the NC-10 into your application. LabVIEW FPGA Module is only required if you send data to or from other FPGA based devices.

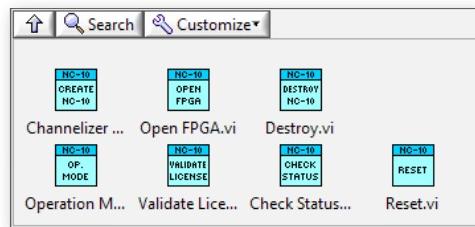
The API allows you to use the Channelizer both as a single FPGA device that communicates with the host PXI through DMA FIFOs or as an FPGA-device communicating with other PXI instruments via the PXI backplane (peer-to-peer streaming).

NC-10 can be used both in Windows and LabVIEW Real-Time Systems.



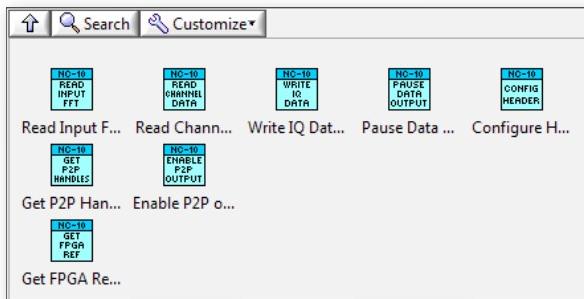
API Features

The API consists of many different VIs and gives you programmatic access to the NC-10. The VIs can generally be divided into three groups, general, data streaming and channel configuration. All Host API VIs are LabVIEW native.



General

VIs that initializes the NC-10 and configures the basic settings such as operating mode and FlexRIO device.

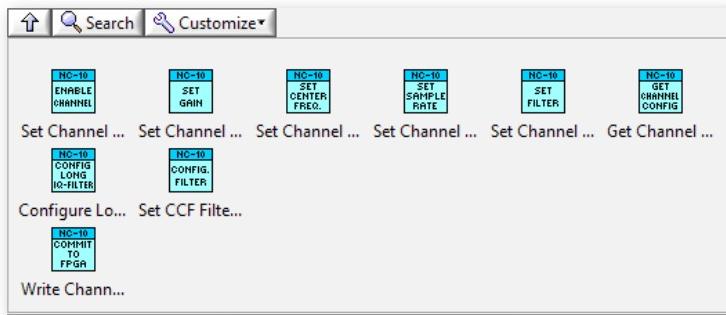


Data Streaming

VIs that lets you configure input source and output destination. You can either send data to/from the channelizer down from the host or use peer-to-peer streaming.

Peer-to-peer reader and writer handles are obtained through the API and can then be used together with NI peer-to-peer VIs to connect NC-10 with streaming sources or sinks. Once the channelizer is connected to other peer-to-peer streams data input and output can be enabled or disabled

For the advanced user it is possible to obtain an FPGA reference to the input and output FIFOs to optimize the data streaming performance in the application.



Channel Configuration

Contains VIs that lets you configure the 1024 channels of the channelizer. The tunable parameters such as center frequency or filtering can either be set individually for each channel, all parameters for one channel, or multiple channels at the same time. If an incorrect configuration is applied, informative error codes tells you how to fix them. Changes are committed to the FPGA with a certain VI call.

NC-10 Specification

Channelization Specifications

Input rate (I/Q), f_{in}	≤ 250 MSps
Number of output channels	1024
Data width (in and out)	16-bit I, 16-bit Q
Output channel center frequency resolution	$f_{in} / 2^{32}$
Output channel sample rate	Min: $f_{in} / 32768$ Max: 62.5 MS/s or f_{in} (whichever is lesser)
Output channel sample rate resolution	$\leq f_{in} / 2^{30}$
Maximum guaranteed aggregate output sample rate	125 MSps
Maximum achievable aggregate output sample rate	250 MSps
SFDR	>80dB
Output channel alias-free bandwidth	80% of output sample rate
Output channel alias filter rejection	>80dB
Output channel passband ripple	< +/-0.1dB
Output channel programmable gain	0dB : 0.1dB : 102.3dB
Number of filters (Single Sample Mode)	32
Number of filter taps per filter	31

Signal Processing

Input FFT length	32768
Number of filters (Filtered Samples Mode)	1024
Number of filter taps per filter	108

About Novator Solutions

Novator Solutions is a company based in Stockholm, Sweden, that develops test and measurement systems and provides consultant services. We are a National Instruments Silver Alliance Partner and work extensively with the hardware and software platforms from National Instruments. All developers are experts on developing systems based on these platforms, making it possible to deliver systems of the highest quality to our customers.

Our Partners

National Instruments (NI) is an American company based in Austin, Texas, with over 7000 employees worldwide. NI provides an integrated hardware and software platform that helps engineers and scientists in nearly every industry. NI RF products and solutions span from design to test. Their high-performance PXI platform and RF instrumentation deliver unprecedented flexibility, accuracy, and measurement speed.

RFEL is a UK based Technology Company providing high specification signal, image and video processing solutions to government, defence, security and industrial customers.

As world leaders in high performance software defined digital receiver designs for Electronic Warfare systems, RFEL offers rapid and flexible design services based on an extensive library of multi-award winning, patented FPGA IP-Cores.

